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種皮破傷과 GA_3 處理가 Egremont russet 사과의 種子 發芽, 苗의 生長 및 生理的 矮化에 미치는 영향

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A Study on the Germination, Seedling Growth and Physiological Dwarfism of Apple Seed affected by GA_3 and Scarifications

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Introdution

Seed dormancy involves mechanical dormancy caused by seed coats barriers, physiological dormancy by ripening degree of the embryo within the seed during stratification and biochemical dormancy by various enzymes and components. Generally, it is required for a long period of time for the seeds to finish dormancies and sometimes growers treat the seed with some chemicals or operations to hasten dormancy breaking.

There were numerous literatures concerning on dormancy, breaking methods of dormancies and levels of inhibitors containing in the apple seed (1, 2, 8, 13, 15, 16). Rudnicki (1974) demonstrated that ABA content in the cotyledon is higher than thatof the embryo and the seed coats of apple seed (5, 10).

Futhermore, effect of ABA contained in the seed and exogenous growth regulators on the seed germination were published by Kaminski in 1970. But effect of GA_3 treatment to the apple seed is depending upon degree of after-ripening of the embryo in the seed (9). Germination, seedling growth and physiological dwarfism were not experimented with the after-ripened seed by various scarifications. This work was attempted to know the effect of seed coats on germination, seedling growth, physiological dwarfism and overcoming effect of dwarfism by GA_3 treatment and removal of seed coats barriers.

Materials and Methods

The apple cultivar selected for this experiment was Egremont russet growing at attached orchard of the Royal Danish Veterinary and Agricultural university. The fruits have harvested on 8th October in 1979 and have stored for 6 months at 2 - 5 ℃.

The seeds used in this experiment were collected during April in 1980. Scarifications were made as described in Fig. 1.

Item No.	1	2	3	4	5
Scarification					

* Black lined portion were removed.

Fig. 1. The various scaritication methods.

These scarified seed was soaked in GA_3 100 ppm solution for 24 hours and the seed of control plot was soaked in distilled water as the same hours. Treated seeds were placed on the moistened filter paper in petri-dishes of 9 ㎝ in diameter. In each plot, 20 seeds were placed with 3 replications. These petri-dishes were put on the shelves of 18 ℃ germinator without illumination. Seedling growth was measured on the upper part, hypocotyl and lower part; primary root from embryo axis. The diameter of hypocotyl was also investigated and greening degree of cotyledon was judged as visually to identify the physiological dwarfism and normal and abnormal seedling growth.

Data submitted in this paper were calculated as average from 3 replications.

Results and Discussion

Germination percentage of Egremont russet apple cultivar by the various scarifications were shown in Table 1. Item No. 5, 1/2 sectioned cotyledon after seed coat removed as in Fig. 1. showed the highest percentage by 55 % when treated with GA_3 and 45 % at control plot of the same scarifications, seed coat removed plot, sharp part of the seed coat removed plot and the round part of the seed coat removed plot in decreased order.

Germination percentage of the intact seed was only 5 % and the seed removed at round and sharp parts showed 10-5 % respectively as shown in Fig. 2 and 3.

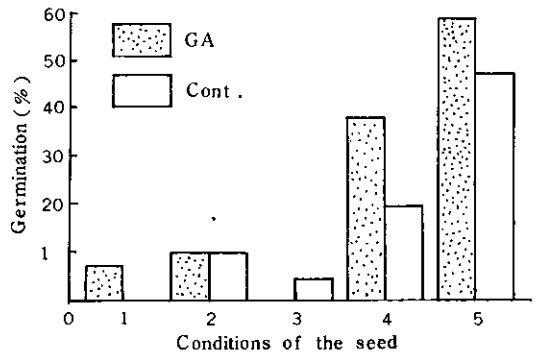

Fig. 2. Germination percentage of Egremont russet apple cultivar according to the various scarifications.

Table 1. Germination percentage and seedling growth russet apple according to scarifications.

	Chemicals Plot	No. of seed treated	A	B	C	D	E
1	GA	20	5	7.0	4.0	1.5	EY. PD
	Cont.	20	5	2.0	12.0	1.0	EY. PD
2	GA	20	10	13.0	10.0	1.7	EY. PD
	Cont.	20	10	10.0	14.0	1.1	EY. PD
3	GA	20	0				
	Cont.	20	5	5.0	3.0	1.2	EY. PD
4	GA	20	35	36.3	19.6	1.3	YG
	Cont.	20	20	38.0	32.6	1.2	AG
5	GA	20	55	15.4	6.7	2.1	AG. PD
	Cont.	20	45	16.6	32.4	1.5	AG

A;Germination percentage.
B;Hypocotyl leng
C;Primary root length.
D;Hypocotyl diameter
E;Identification of physiological dwarfism.
EY;Entirely yellow of cotyledon.
YG;Yellowish green of cotyledon
AG;All surface of the cotyledon is green.
PD;Physiological dwarfism.

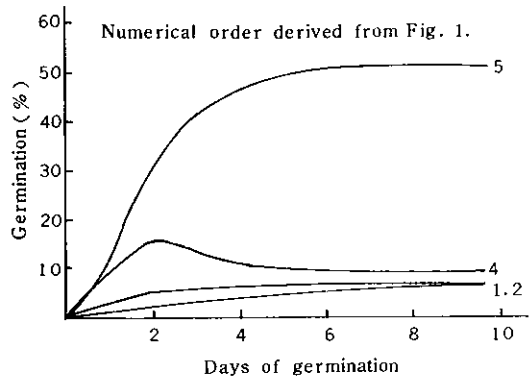

Fig. 3. Germination percentage Of Egremont russet apple cultivar for 10 days.

The reason of the highest germination at item No. 5 plot can be supported by the experiment which showing the highest ABA content in the cotyledon(6, 7, 9, 10, 14).

The seeds not scarified and the seeds removed only their round part were low in germination percentage. It is believed that the seeds usually contain high ABA level and slow absorption of water for hydrolysis of protein and starch in the endosperm by seed coat barriers. It is also believed that physiological dwarfism of the seedling from the intact seed was based on the effect of inhibitors and low activity of enzymes (3). Color of the cotyledon formed from the intact seed showed yellowish. This result was suported by the experiment of Lewak and Come (1977) that the intact seeds placed at 5 ℃ and 20 ℃ did not germinated because of low activity of peroxidase but when removed their seed coat, germination occurred with increased activity of this enzyme (1). Degree of greening on the cotyledon showed the same tendency as the results of the experiment conducted by Lewak and Wyzinska (3).

Therefore, production of normal seedling can be expected by use of fully after-ripened and stratified seeds. ABA contained in the apple seed also metabolites as phaseic acid and dihydrophaseic acid during cold stratification period as shown in Ash tree by Ernest et al, the author believed (4).

Thus the physiological dwarfism of the seedling can be exempted by cold stratification and removal of the seed coat rather than warm stratification after seed collection (17). The seedling produced from the seeds removed their seed coats elongated more vigorously than the other plots as shown in Fig. 4.

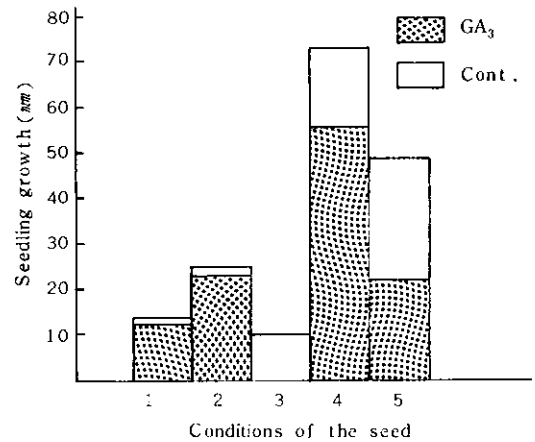

Fig. 4. Seedling growth according to the various scarifications.

The seed treated with GA_3 also showed retarded growth. Generally, GA_3 affects on the stem growth but elongation of stem was unaffected and retarded by limitation of auxin formation in tissue of the plant. This results also nearly similar with the fact that GA_3 application to a certain plant influences on the growth of stem depending upon species and within varieties (9). The seeds treated with GA_3 in this experiment showed retarded stem elongation of Egremont russet apple cultivar as Acer seedling elongation, on the length of hypocotyl between GA_3 treatment and control plot at item No. 4 and 5 as shown in Fig. 5.

Many researchers in this field of study also demonstrated that the seeds stratified over 60 days were retarded their length of hypocotyl by treatment of GA_3, BA and Kinetin (9, 12), But diameter of hypocotyl produced from the seeds treated with

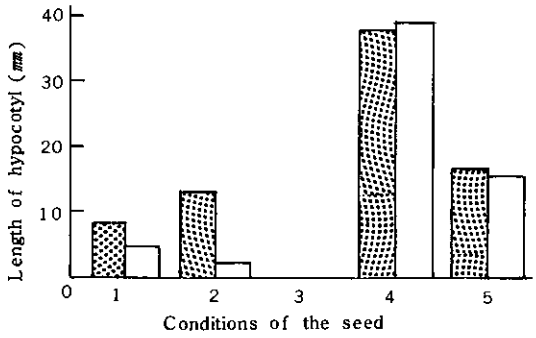

Fig. 5. Length of hypocotyl grown for 10 days in various scarifications.

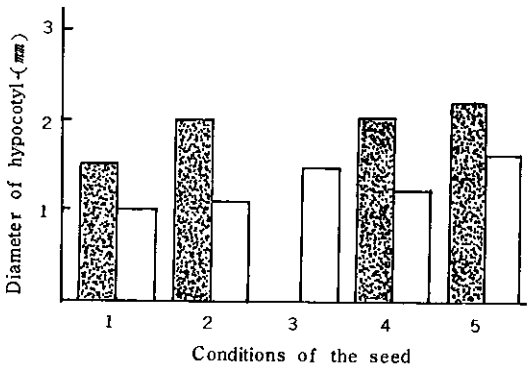

Fig. 6. Diameter of hypocotyl according to the various scarifications for 10 days.

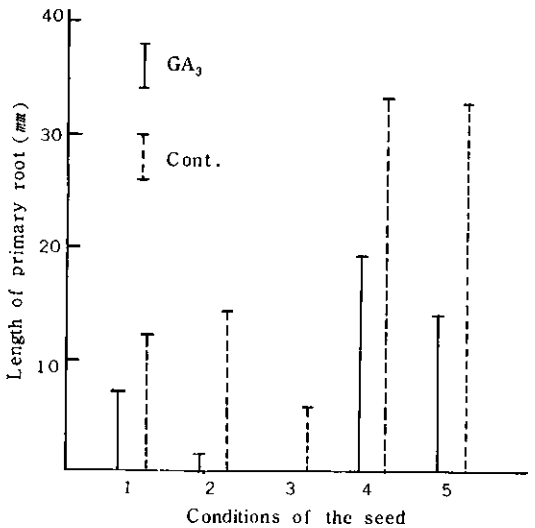

Fig. 7. Length of primary root grown for 10 days in various scarifications.

GA_3 was higher than the other plots. While length of primary root was shorter at GA_3 treatment in each scarifications as in Fig. 6 and 7. Though item No. 5 plot showed more retarded tendency on hypocotyl and root growth than seed coats removed plot, there were rather a little difference on the growth of seedling because ABA content in the seed was decreased as half by removal of cotyledon.

In general, physiological dwarfism is occurring when the seed was treated by cold treatment insufficiently. That symptoms can be judged by different greening speed of both cotyledons. imbalanced growth of hypocotyl and primary root, and stunted leaves at the top portion of the newly formed shoot so called abnormal seedling at the stage of early growing period.

Physiological dwarfism of the seedling was appeared from all of the GA_3 and control plots of item 1, 2, and 3. except item 4 and 5. The most serious symptom was found at the plots of item 1 and 2 because of ABA content in the seed coats the author believed. This results were the same as the cases of apricot and peach seedling described by Khan (1980).

These symptoms were disappeared when the seedlings continue their growth for a long time and can't overcome by GA_3 treatment because the seeds were stored with the fruit flesh which emanate volatile substance inhibit seed germination, the author believed.

Thus, it is believed that physiological dwarfism is overcoming by sufficient naked cold stratification and removal of seed coats when immatured.

Conclusion

Germination percentage and early seedling development of Egremont russet apple cultivar were investigated in 1980. Germination percentage of the seed which sectioned 1/2 of their cotyledon after seed coats had removed was 55 % at GA_3 plot and 45 % at the control plot of the same seed condition. Low germination percentage was shown at the int-

act and seed coats remained, removed only at round and sharp part of the seed. The length of hypocotyl after 10 days from germination was stimulated by GA_3 treatment at intact and seed coat remained plot a little but as a whole, hypocotyl was more elongated at the seed coats removed plot than that of seed coats remained plots. While the length of primary root by GA_3 treatment at all plots showed retarded growth but diameter of the root was higher. Physiological dwarfism was occurred at the seed coats remained plots, while greening of the cotyledon was hastened on the seed which sectioned 1/2 of the cotyledon after seed coats had removed.

Acknowledgement

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摘　　要

Egremont russet 사과 品種의 종자에 여러가지 種皮 破傷을 한 후 發芽, 幼芽, 幼根의 生長과 生理的인 矮化에 對하여 조사한 결과 다음과 같은 결과를 얻었다.

子葉의 크기를 1/2로 절단하고 種皮를 除去한 Egremont russet 사과 品種의 種子에 GA_3를 처리한 것은 平均發芽率이 55%였으며 同一條件에서 對照區는 45%였다. 그리고 種皮가 完全한 것과 種皮破傷을 한 區에서는 낮았다.

幼芽長은 種皮를 완전히 남긴 것과 破傷한 區에 GA_3를 처리하였을 때 促進되었으나 全體的으로 볼때 種皮를 除去한 區에서 더 길었다.

그러나 幼根長은 GA_3처리에 依해서 抑制되었으나幼根의 直徑은 더 커졌다.

그리고 生理的인 矮化는 種皮를 남긴 區에서 發生되었으며 GA_3 처리에 依해 극복되지 않았다. 子葉의 綠色化 속도는 種皮를 除去하고 子葉의 크기를 1/2로 절단한 區에서 促進되었다.

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